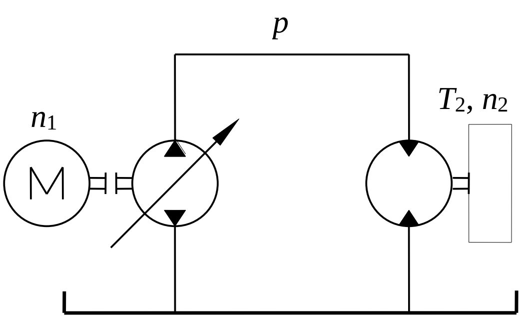
MEC-E5003 Fluid Power Basics
Calculation Exercises 2
Spring 2017

EXERCISE 4

The adjacent system encompasses pump and hydraulic motor. The rotational speed of the motor is required to be $n_2 = 400$ r/min when the load torque is $T_2 = 300$ Nm. This calls for input pressure of $p = 14$ MPa at the inlet port of the motor. The total efficiency of the motor is $\eta_{t2} = 0.83$.

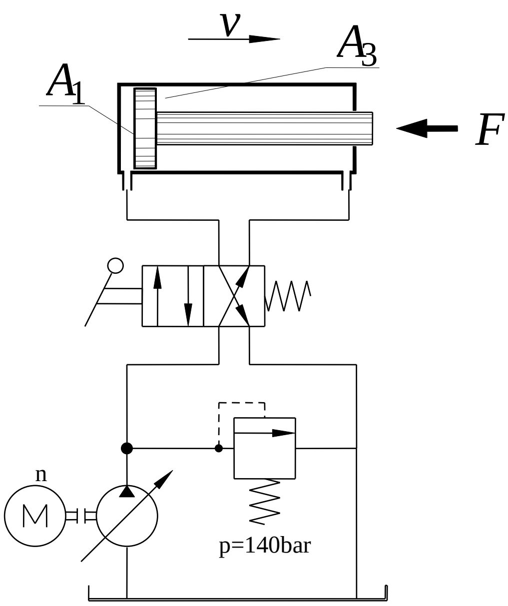


What is the required inlet flow to the motor in this case?
What is the required displacement (per rotation) of the pump, when it is driven with an electric motor that rotates with speed $n_1 = 1000$ r/min?
Calculate the pump produced hydraulic power and the mechanical power needed to operate the pump.

The volumetric efficiency of the pump is $\eta_{v1} = 0.95$ and the total efficiency is $\eta_{t1} = 0.82$ at the given pressure level.

EXERCISE 5

In the adjacent system, the piston velocity is controlled by altering the pumps displacement.



a) What is the required pump setting (in per cents of maximum displacement) in order to reach velocity of 2 cm/s.

b) Define the input power required by the pump, power output of cylinder and the total efficiency of the given system (from pumps mechanical input to mechanical cylinder output, at previously mentioned operational point).

Pressure losses in the flow control valve are neglected.

$V_{\text{rad max}}$ = 0.6 cm^3/rad , n = 1460 r/min

$\eta_{\text{v,p}}$ 0.87, $\eta_{\text{hm,p}}$ = 0.94

A_1 = 20 cm^2, A_3 = 10 cm^2, $\eta_{\text{v,c}}$ = 1.0,

$\eta_{\text{hm,s}}$ = 0.93 , F = 18600 N

EXERCISE 6

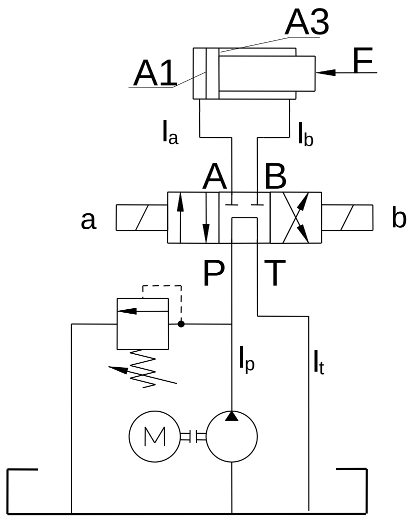
Calculate the pressure in the output port of the pump when

a) Magnet a is energized. Only the pressure losses of the valve and resisting load force F (direction as depicted) are taken into account.

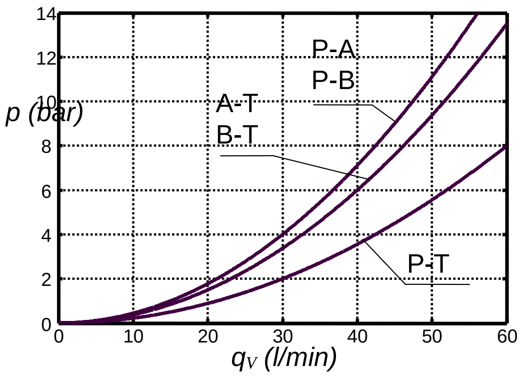
b) Magnet b is energized. Only the pressure losses of the valve and resisting load force F (direction opposing to depicted) are taken into account.

A_1 = 31.2 cm^2 , A_3 = 25 cm^2 , $q_{\text{V,p}}$ = 42 l/min , ν = 25 cSt , ρ = 900 kg/m^3

F= 30 kN



A3
A1
F
la
lb
A
B
a
b
P
T
lp
lt
M



p (bar)
qV (l/min)
P-A
P-B
A-T
B-T
P-T
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60